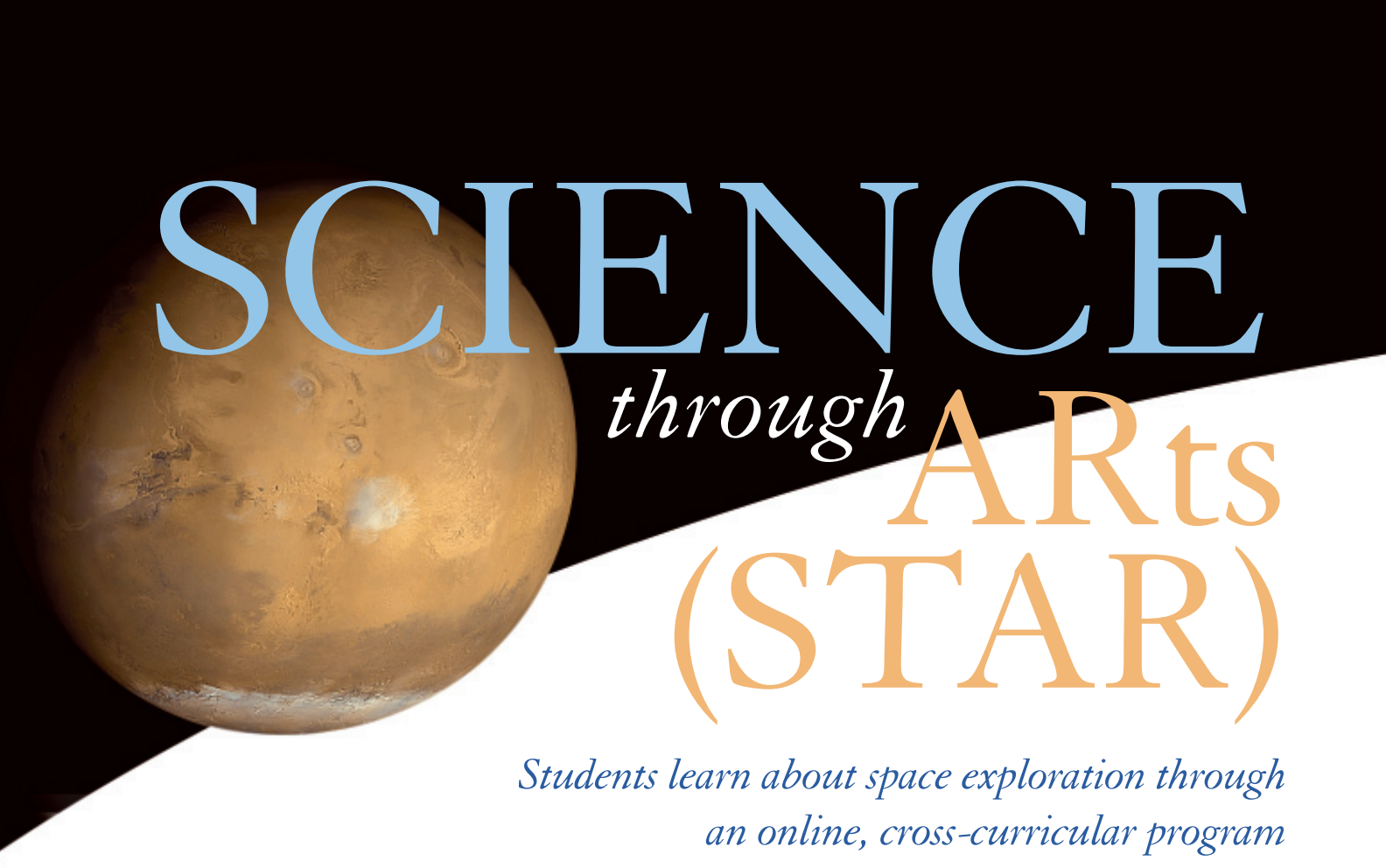


SCIENCE through ARts (STAR)

Students learn about space exploration through an online, cross-curricular program

Marycay Densmore, Joseph C. Kolecki, Allan Miller, Ruth Petersen, and Mike Terrell

The relationship between discovery and exploration has driven human curiosity for all of recorded history. Space exploration is the perfect theme to inspire and motivate the next generation of explorers. Science Through ARts (STAR) is a free, international, cross-curricular program thematically aligned with *The Vision for Space Exploration*, a framework of goals and objectives published by NASA in February 2004.

Through the STAR program, students in grades 5 through 12 are encouraged to apply their knowledge in creative ways as they approach a real-world problem involving space exploration. Students collaborate with one another and make their own choices as they work toward developing stories and screenplays related to the program's theme: the theme discussed in this article is Mars Exploration. Through videoconferencing with NASA scientists, experts, and other schools, students learn how scientists and their peers think and work. Students are given additional motivation to excel because the final product of their hard work is available online.

Students who participate in STAR use technology and language skills while learning science. The program content includes

- Participation suggestions for educators, media specialists, and students of many disciplines;
- Investigations related to space exploration;
- Educator-recommended science fiction;
- Videoconferences with NASA to discuss space exploration, the science of exploring space, and ideas for science fiction stories;
- Videoconferences with the Cleveland Museum of Art to study how the Moon has played a role in different cultures;
- School-to-school videoconferences to share information or debate topics;
- Videoconferences in which participating students share their science fiction final projects with NASA and each other; and
- Posting of the final stories and student self-evaluations on a NASA website.

The first theme chosen for STAR in the 2003–2004 school year was Mars Exploration, which was timely because of the landings of the Mars Exploration Rovers *Spirit* and *Opportunity*. The following case studies, written by four teachers who participated in the STAR program, provide insight on how the teachers incorporated the program into their curricula.

Case study 1

by Marycay Densmore, science teacher (CA)

My students became fascinated with NASA's exploration of Mars, especially after they were given the rare opportunity to videoconference with NASA scientists. After this unique experience, I learned more about STAR and got my students involved in the program.

Through this program, students worked collaboratively, conducted internet research, debated other STAR students via videoconferencing, connected with NASA scientists via e-mail and videoconferencing, studied science fiction through television shows and novels, created stories on the human exploration of Mars in the form of screenplays, and shared the best screenplays as movies via videoconferencing.

At the beginning of the program, students were given reading material and internet resources and asked to begin designing a "Mission to Mars." To gather information for essays, debates, and screenplays, students also formulated questions for NASA scientist Joe Kolecki. During videoconferences, Kolecki answered questions and provided students with many "aha" moments and stimulating material to digest concerning Mars. Students held debates and then wrote essays about whether or not we should explore Mars. The top debaters were chosen to compete against another STAR school via a videoconference to debate the topic in depth.

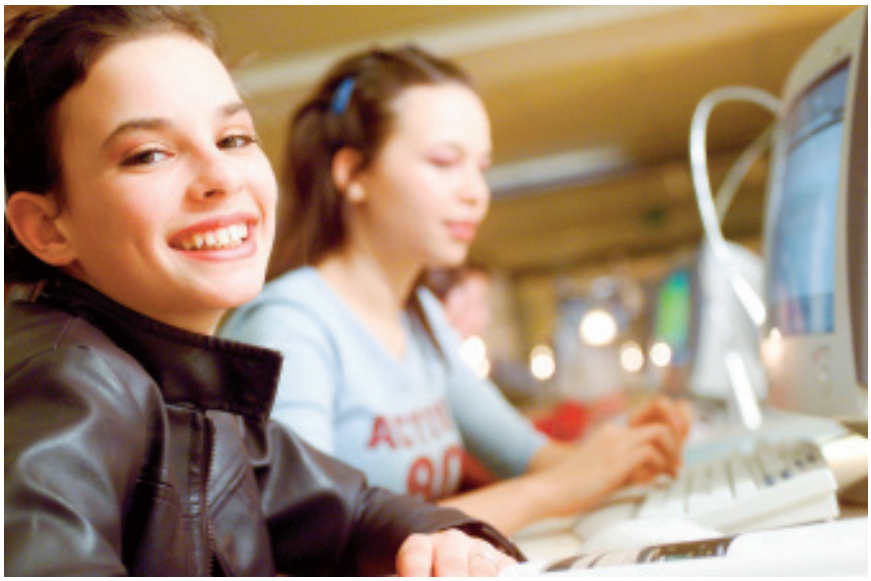
To observe the many twists and turns that science fiction writers use to captivate their audiences, students spent class time watching episodes of *The Twilight Zone*, *The Outer Limits,* and *Quantum Leap* on the SciFi Channel and reading *Tomorrowland* by Michael Cart (1999). Based on the scientific information learned through research, debates, videoconferencing, novels, and films, students worked in small groups to create screenplays. The best screenplay, *Unexpected Detour*, was converted into a movie and shared with NASA and three other STAR schools (including one from Japan) via videoconferencing. *Unexpected Detour,* which took place in the year 2162, was about a NASA astronaut crew on a mission to explore Jupiter's moon Europa. A collision with a micrometeoroid caused an unexpected detour to Mars, and the team worked together to avoid a crisis.

When students shared the knowledge that they gained with other schools, students were provided not only with a community service project, but an authentic learning experience. Many students commented on how much they learned from and enjoyed the program; it may have even encouraged some students to become future NASA scientists.

Case study 2

by Mike Terrell, science teacher (MI)

Southfield High School (SHS) is one of the many suburban schools nestled around Metro Detroit's Motor City technology hub. However, the focus at SHS is not auto-



motive technology, but space—the final frontier. Students in the NASA Aerospace Studies program at SHS are provided instruction in three basic areas: aviation and its history, rocketry, and astronomy.

The astronomy component, in particular, has been enhanced by our students' involvement in STAR. For two years, students have been able to take an in-depth look at Mars through the eyes of NASA scientist Kolecki via videoconferencing. Students have produced fascinating short stories with the resources provided through NASA. One story produced by SHS students during the second year, for example, even included three-dimensional images and Japanese subtitles (one of the other schools we held a videoconference with was in Japan). The story involved a catastrophe on Earth that forced the "United Earth Nations" to join forces and save humanity.

As a direct result of the STAR program, students were well prepared when asked to make a presentation at a national NASA Explorers School Student Symposium at the Kennedy Space Center in Florida last spring (see "On the web"). Students have also come to understand and appreciate the immense role that NASA plays within the lives of everyday people and anticipate a new season of videoconferences that study the mysteries of the Moon.

Case study 3

by Ruth Petersen for Ryuzo Tanaka, science teacher (Japan)

For two years, 10th- and 11th-grade students at Ikeda High School in Osaka, Japan, have participated in STAR. During the first year, our Japanese students wrote a short story about Mars in both English and Japanese, which was illustrated in PowerPoint with original music files.

The second year, students performed, produced, and recorded film clips to add to the original story. To share our stories with other students, our school held a videoconferencing session with students at Mesa Verde in California. Student reactions to the program were positive. One student said, "The two years I participated in the STAR project were the most fulfilling so far. I enjoyed every single part of our activities. Although I can't continue in the project, all that I experienced, felt, and learned will be with me whatever I do." Another student added, "I was educated in a new way and I was able to look at science education from a new perspective."

Case study 4

by Allan Miller, science teacher (AK)

Science in general, and space specifically, has always been a huge theme in my classroom. In Alaska, there are no standardized tests for science at any time from grades K–12. The focus is specifically on reading, writing, and math, with everything else seen as "the icing on the cake." Therefore, space science must be integrated with required material. The answer lies in interdisciplinary units that connect writing, reading, math, science, social studies, and the arts.

The STAR initiative provided a way to link writing and art with science. Using student-written science fiction stories, the program offered connections with NASA scientists via videoconferencing and e-mail, as well as collaboration with other schools around the country.

The STAR unit began with a comparison study of Earth and Mars. Using the links from the STAR website and others, students worked in teams to study the atmosphere, climate, moons, and geology of both planets to identify similarities and differences. With the landings of *Spirit* and *Opportunity*, there was no shortage of newspaper, magazine, and Internet articles to draw upon. As we studied latitude and longitude in social studies, students applied the same skills to locate various features on a Mars surface map. In art class, students studied the collages of Eric Carle (see "On the web") and created collage landscapes of the Martian surface. Journals developed by students during this experience provided a wealth of material for them to draw upon later for science fiction stories. Our first videoconference with NASA scientists provided students with background on what is known about Mars as well as faces that students could connect with.

Students read *The Green Book* by Jill Paton Walsh (1986). A central theme in the book is the colonists' attempts to develop sustainable agriculture on a new planet, which provided links to a biology unit on hydroponics through Seattle's Museum of Flight (see "On the web"). Students followed the development of brassica plants grown in hydroponic cubes and conducted videoconferences with NASA scientists working to de-

velop a "salad machine" and plant-based life support system for the International Space Station. Students discussed how science fiction becomes much more believable when it contains strong elements of accurate science—such as a realistic solution to what the crew would eat on their seven-month journey to the Red Planet.

Students also read H.G. Wells' *War of the Worlds* (1993), and discussed the author's powerful technique of introducing a single unnatural element and following the natural reactions of people to the situation. After reading Madeline L'Engle's *Wrinkle in Time* (1976), students began to write their own short stories that focused on developing strong characters that face and resolve conflicts related to a mission to Mars.

In art classes students created papier-mâché models of characters; several chose to use their original Mars landscape collages as a setting. Once students had completed their stories, they shared them within the class and selected three to share during a videoconference with NASA scientists and students from another STAR school in Minnesota. The online performance aspect is a tremendous motivator for students and greatly improves the quality of their work. STAR was definitely one of the best additions to my classroom last year, and we are looking forward to shifting gears for the future program: "An Eye on the Moon."

A multiplexed approach

by Joseph Kolecki, NASA scientist

The world is moving ahead at leaps and bounds and we are all striving just to keep up. Education can no longer afford the luxury of teaching subjects serially as isolated, individual disciplines. An integrated approach has become necessary, one in which students are exposed to their subjects in parallel fashion, a "multiplexed" approach. The STAR approach offers that possibility.

This program provides students with the opportunity to think for themselves. Because of standardized testing, there is little time for showing students how to integrate knowledge into their daily lives, or how to use it in independent or creative thought. STAR offers students the opportunity to think, explore, be creative, and *formulate and ask questions.* Scientists are scientists not just because of what they know, but because they are curious enough to ask questions and explore what they do *not* know. Scientists are able to explore questions through experiments and mathematical models. As a NASA scientist, my own questions were asked of the planet Mars. They took over a decade to properly formulate, but my experiments on wheel abrasion and rover electrostatic charging have flown on *Pathfinder*, *Spirit*, and *Opportunity*.

STAR, which enables students to touch this realm of seeking out and posing questions, involves a radical shift in teaching and learning. Teachers become guides—rather than the dispensary of facts to be memorized—to point the way across an increasingly complex information landscape. Students, for their part, become genuine 21st century explorers of the Information Age. Like *Spirit* and *Opportunity*, students cross new landscapes of learning and imagination. Using teachers and scientists as their guides, students possess the intelligence and enthusiasm to traverse this unfamiliar terrain, and real learning occurs. ■

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Acknowledgments

The STAR program is offered through the NASA Digital Learning Network (DLN), which is managed nationally by the Technology and Products Program Office at NASA Headquarters in Washington, D.C., and locally by the Educational Programs office at the NASA Glenn Research Center in Cleveland, Ohio.

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The Vision for Space Exploration: *www.nasa.gov/missions/solarsystem/explore_main.html*